IFAMD Market Commentary 06/2013

- An Electricity Market Design for a Secure Energy Transition -

The IFAMD Institute proposes an electricity market design which, on Germany's path to a renewables-only energy supply, leaves the choice of the efficient mix of power plant technologies to the market and thus restores security of supply and planning.

Some say that an electricity supply based solely on renewables is possible. Others say that the costs would be extraordinary. To a greater or lesser extent, sooner or later, both sides will be right. The real question is *how soon* the energy transition ("Energiewende") will be completed and *how great* the costs will be.

Renewable energy is only available in times of sufficient wind speeds, sufficient sunlight, or sufficient rainfall to fill the reservoirs. Thus, renewable energy by itself cannot be planned or marketed for the long term; it only becomes available at short notice. To fully rely on renewables means for the electricity market to expose itself to rapidly fluctuating excess supply or demand. The result is highly variable prices and low planning security, including the risk of blackouts with incalculable costs.

Already today the German electricity market is characterised by a relatively large volume of trade in the short-term market segment. The large supply of extremely cheap renewable energy is very tempting for utilities that hope to make a margin from buying cheaply on the spot market. When offered, renewable energy is unbeatable: Marginal cost is close to zero, leaving other suppliers without a chance. Yet what is really "expensive" about renewable energy is the uncertainty as to whether and when exactly it will be available. The entire electricity grid then becomes literally dependent on the weather.

In theory, a renewables-only scenario can only be realised without such high market volatility if we provide for enough power storage capacity. The electricity must be stored in times of excess supply and released when needed. Only insufficient storage technologies are available as yet but research is underway with major advances in sight. Once available on a sufficient scale, the operators of such storage capacities will be able to offer option products on the forward market that effectively serve to pacify the market.

The electricity market design proposed by the IFAMD at the core comprises the introduction of such option products already today, which essentially amounts to a mandatory insurance for volatile energy sources. Such insurance is to be offered either by storage capacities or, until storage becomes available on a sufficient scale, by flexible conventional power plants that can physically balance the volatile renewable feed in.

From today's perspective, the most promising electricity storage technology which could sustain a renewables-only scenario in the foreseeable future is the generation and subsequent combustion of gas. Such so-called "wind gas" is chemically synthesised in times of excess wind power supply and is then fed into the natural gas grid. To reconvert this wind gas to electricity, however, we need: *gas turbines* or *combined cycle gas turbine (CCGT) power plants*. Since these power plants also burn natural gas, which sadly is not renewable, they do not count as renewable energy sources and therefore do not enjoy the *Renewable Energy Act's* priority feed in or even the feed-in tariff. This is a real dilemma – but it gets worse.

What is paradoxical about the market situation of a large volume of trade on the spot market is the fact that the demand for power is fairly easy to forecast and to plan over long periods of time, and simultaneously, on the supply side, the development of power plant projects also takes many years from the investment decision to commissioning. Moreover, final power customers, be they private or commercial, greatly value security of supply and planning. All of these clues speak in favour of a highly developed forward market.

However, the renewables' above-mentioned extremely low marginal cost in conjunction with their volatility of supply causes the current high trade volume on the spot market, entailing large opportunities but of course also risks for the utilities that trade on the market. In game theory, this effect is referred to as "cherry picking". For investors who would otherwise be willing to build and operate the much-needed CCGT plants, what this means first and foremost is a lack of planning security. It is currently utterly impossible to predict how the operation of CCGT plants will be regulated in ten or fifteen years and what prices they will be able to achieve. On the spot market, which as of today dominates the electricity markets, CCGT power does not stand a chance relative to, for example, renewable energy. This is why we see far too few CCGT power plants being built, even though this is exactly the type of plant that is particularly valuable in a renewables-only scenario. This is essentially the dilemma mentioned above.

A number of approaches to a better electricity market design are currently being discussed to address this dilemma. We have examined the arguably most prominent solution approaches, some of which have already been implemented in a range of international markets. The resulting evaluations and recommendations are briefly summarised as follows:

Administrative capacity payments are promised to prospective investors in urgently needed power plant capacities. The investors receive the payments as a public subsidy simply for making the capacity available, in addition to the proceeds they obtain from selling their power on the electricity markets. This solution in essence relies on the skill of public administration in specifying plans for the energy technology mix. Inefficiencies are therefore unavoidable.

The widely favoured *capacity auctions* at closer inspection are a variant of the capacity payments whose size is merely determined by a market mechanism: A bidding procedure will ascertain which of the prospective investors in power plant capacities is willing to go forward with the lowest level of subsidies. The problem of the public decision as to what amount is required of which technology remains unaddressed also in this "solution". The idea of a market-driven allocation of technologies is compromised.

In the short term, maintaining a so-called *strategic reserve* will be inevitable. The reserve comprises power plant capacities that are kept in a state of readiness in return for public funds to help out in the occasion of a power supply shortage. The necessity of such measures alone serves to demonstrate the shortcomings of the current electricity market design. Here, too, a central authority is required to decide on the volume of the reserve. Just like the other "solutions", the strategic reserve in the long term cannot constitute an efficient electricity market design that might yield an optimal, dynamically adapting mix of technologies.

Based on these market observations, we have come to the conclusion that only the *revitalisation of the long-term energy trade* can enable an allocation of power generation technologies by the free market. Insurance-like option models, so-called "*reliability options*", shall allow renewable energy to be combined with conventional energy and thus to be traded on the forward markets. Investors will make the business decision to build new CCGT plants or invest in any other power generation technology only if they can reasonably expect sufficient demand for their plant at an early stage, which presupposes that they can fairly compete on the long-term forward market with, rather than against, renewable energy. Due to their low marginal cost, the renewables will prevail also on the forward market. Together with their "enablers on the forward market", e.g. CCGT plants, a technically viable mix of technologies will ensue. Whether and to what extent CCGT technology, for example, will be required for that purpose is a question that can be answered, once and for all and in the course of the dynamic transition, only by the market.

How such a reliability option may be designed and how it takes its effect can nicely be illustrated using the tale of the "Baker and the Good Fairy". In the tale, the baker assumes the role of conventional power plants and the good fairy proxies for renewable energy.

The Baker and the Good Fairy

In a small town, a consumer buys a bun priced at €1 each day, thus spending €30 on buns each month. The local baker's fixed cost (per consumer) is €10 per month, the marginal cost per bun is 40ct. From this we calculate his profit as revenues of €30 less costs of €22, yielding a monthly profit of €8 – a stable situation both for the baker and for the consumer.

One day, a good fairy comes to the small town. Whenever the sun shines, she is able to give away a bun for free, at no fixed cost to herself. The local probability of sun shine is 50%.

If the fairy gave all her buns to the consumer, the baker would be left with revenues of €15 and costs of €16, meaning he makes a loss and must consequently go out of business. The consumer would have saved a lot of money but could enjoy a bun on only 15 days each month on average. A reliable weather (i.e. bun) forecast would only be available at short notice.

If, by contrast, the baker and the fairy coordinate their actions before the fairy gives the buns to the consumer, they can enter into an agreement regarding the whole month before the start of the month (= forward market). Together they can offer the consumer a bun on each day of the month, at a monthly cost of €16. Meanwhile the consumer's monthly willingness to pay remains at €30. A "cake" of €14 has emerged between the baker, the fairy and the consumer.

In dividing that cake, the first decision to make is whether the "good fairy" will remain exactly that and continue not to demand payment, or whether she would rather claim her fair share of the cake. The latter solution would greatly simplify matters as it might in the best case even obviate the wizard in the background (= Renewable Energy Act), who so far effectively bore the fairy's costs. The game theoretic *solution concept PARTS*[1] *would award the fairy an "added value" of €6 since she enlarged the cake by this amount.*

If, however, the good fairy gives the buns to the consumer "without thinking" and without coordination with the baker, she will destroy the latter's business model and, consequently, also the consumer's security of supply.

The basic idea of the electricity market design proposed by the IFAMD is not only to allow the early marketing of renewable energy on the forward market in theory (that possibility already exists today), but rather to make renewables secure (in terms of security of supply) through their mandatory combination with reliability options. The demand for such options will then give rise to a profitable market for CCGT plants and, later on, storage capacity. The Renewable Energy Act's much-discussed renewables subsidies, which will continue to support renewables for many years to come, could assume a new role in this scenario: Rather than, as today, distorting competition on the power generation side, we propose that the funds could be better used to stimulate the demand for renewable energy on the forward market. The earlier renewable energy is demanded on the forward market, the higher the payment to the demander should be.

[1] Following Brandenburger, A. M. and B. J. Nalebuff (1996), *Co-opetition, Currency Doubleday*: P = Player, A = Added Value, R = Rules, T = Tactics, S = Space.